Integrated Regional Model Vision Phase
Peer Review Panel Meeting #1: Executive Summary
Meeting Date/Time: October 31, 2003, 8:30 AM – 4:30 PM
Meeting Location: RTD Offices, 1600 Blake Street, Denver, CO

I. Executive Summary

The following report summarizes the results of the first Integrated Regional Model (IRM) Vision Phase Peer Review Panel, funded in part by the Transportation Model Improvement Program (TMIP), which is sponsored by the Federal Highway Administration (FHWA). The one-day panel meeting was hosted jointly by the Denver Regional Council of Governments (DRCOG), the Regional Transportation District (RTD), and the Colorado Department of Transportation (CDOT) and was held at the RTD offices at 1600 Blake Street in downtown Denver on October 31st, 2003. Participants included staff from the three above agencies, a panel of modeling experts from across North America, and consultants under contract to support the IRM project. The purpose of the meeting was to begin the development of a "blueprint" for a new modeling system for the Denver region, to include comprehensive redevelopment of all transportation and land use modeling elements.

This peer review session was the first of two to be held for the IRM Vision Phase, and its discussions were focused on outlining planning issues of key importance to the Denver region, and discussing possible model improvements to better address them. The second meeting, tentatively scheduled for March 2004, will review preliminary suggestions for the new model blueprint, and provide detailed, technical recommendations for the final draft of that blueprint.

Jeff May, Erik Sabina, Simon Montagu, and Greg Erhardt of DRCOG facilitated the peer review meeting. Participants in the Peer Review Panel included transportation model experts from BMI-SG, KLK Consulting, the Portland METRO Planning Department, the University of Toronto, the North Central Texas Council of Governments, Environmental Defense, and the FHWA. Key consultants also participated from pbConsult and the University of Washington.

II. Project Background

Near-Term Goals: The Integrated Regional Model Project

The Denver Regional Council of Governments, working cooperatively with CDOT and RTD (the principal transit provider for the Denver metropolitan area), is presently conducting the early phases of the Integrated Regional Model (IRM) Project. The IRM Project is a multi-stage effort, scheduled to be completed by 2005, whose purpose is to replace the existing land use and travel models in the region with a state-of-the-art, fully-integrated modeling system. The IRM Project was initiated following the completion in 2001 of the Travel Behavior Inventory Project, a comprehensive, 1.5 million dollar travel/activity/demographic survey of the metropolitan area, which provided the basic data necessary for the conduct of the IRM project.

The IRM project has been designed to take place in three phases:

- The Model Refresh Phase. In this phase (completion scheduled for January, 2004) the travel model will be shifted to the TransCAD software platform (from the existing MinUTP platform), and will incorporate at the same time a variety of other improvements. This project will put the Denver Regional Model on a more solid foundation while subsequent IRM project phases are conducted.
- The Model Vision Phase. This phase, whose first tasks are already underway, will result in a "blueprint" for an entirely new modeling system, encompassing travel forecasting, land use, data management, and other elements. The Vision Phase project team will incorporate into its design effort advice from the Peer Review Panel, as well as from local policy and technical experts, and the consultant team under contract for the project.
- The Model Update Phase. In this phase, the Vision Phase's model blueprint will be implemented. Preliminary work on this phase already is underway: the project team has selected UrbanSim as the new land use model platform, and is now working with the University of Washington on implementation concepts for the Denver area.

Project funding in excess of the amount of $1 million already is under contract. The project team is seeking additional funding, with the expectation that the total amount available will be adequate to develop a cutting-edge model, but will fall somewhat short of the total necessary to fund all improvements likely to be considered desirable by project participants.

Past Modeling: The Existing Denver Regional Model

Travel demand forecasting in the Denver area has been, for the past 15 years, conducted using a MinUTP-based model, with the following basic characteristics:

- An allocation-type land use model, built in-house, which assigns future development to TAZs based on desirability scores for each TAZ. These scores are in turn based on a variety of characteristics such as proximity to highway and rapid transit facilities, highway congestion, proximity to open space (for household allocation), etc.
- A cross-classification trip generation model, which generates home-based work, home-based non-work, non-home based, internal-external, and commercial trips, with the household trip rates stratified by income and household size.
- A gravity model-based trip distribution system.
- A multinomial logit mode choice model, with transit separated into walk access and drive-access models, but not nested by sub-mode (such as rail versus bus, etc.)
- A ten-period time of day model.
- A static user equilibrium highway assignment system.

This model may be classified as "state of the practice" for major metropolitan areas during the late 1990s. However, it tends to be insensitive to many development and transportation market and policy initiatives currently being pursued in the region. To effectively support the planning of those initiatives, DRCOG feels that it must make significant improvements in the regional modeling system, employing the latest advances in modeling research and practice.

Present Modeling: The Refreshed Model

The product of the IRM Refresh Phase, now nearing completion, will be a significantly improved regional model, to be used while the next generation model is being developed. The refreshed model will include the following improvements:

- A TransCAD-based model, replacing the old MinUTP-based model.
- New trip generation, trip distribution and other parameters, derived from the Travel Behavior Inventory Project's survey of households and travel in the region.
- A new parking cost model, and a new areatype model.
- A mode choice model re-calibrated against the recent survey data.
- Calibration to match speed study data recently acquired by DRCOG.

In addition to providing more accurate results, this model should greatly enhance DRCOG's ability to support regional planning and policy analysis, as the data management and presentation capabilities of TransCAD are greatly superior to old DOS-based software such as MinUTP.

New Modeling: Expectations for the Updated Model

The foundation of all Vision Phase work is a "wish list" of model improvements, which the project team has been assembling for several years, and which will be augmented as the project team works with the Vision Phase panels. The project team's philosophy at this stage is that everything is "on the table" as the Vision Phase begins. The panels will help us to assess the feasibility of all desired improvements, to prioritize them, and to select those to be included in the project, given the inevitable funding constraints. It is not yet possible to say with certainty what elements will be included in the new model. However, the project team's current expectations include:

- A land use model which predicts development patterns based on fundamental microeconomic principals: of all available land use modeling systems, UrbanSim best satisfied this requirement, in the judgment of the project team.
- More fully-developed integration between land use and travel model elements.
- A richer depiction of household characteristics, probably based on the "synthetic population" method, which in turn will support richer sets of independent variables in various choice models.
- A more realistic trip generation and trip distribution system than the existing model (which uses separate-purpose, cross-classification trip generation and a gravity model), most probably based on a tour-generation system and a destination choice model.
- A nested logit mode choice model to replace the current multinomial logit model.
- A variety of other model improvements such as better toll analysis capability, improved travel time-of-day evaluation (possibly including a time-of-day choice model), better estimation of transit demand details such as park&ride lot demand, and possibly some activity modeling elements, such as enriching the model choice model inputs with an auto availability model coupled with an intra-household trip interaction model and a trip duration element (which would permit the mode choice option set to be conditioned on the actual auto availability for any given trip.)

These and other possible improvements will be evaluated and decided upon during the Vision Phase.

III. Local IRM Panels: Technical and Policy Panel Recommendations

In addition to the institution of the Peer Review Panel, DRCOG, RTD, and CDOT also have convened two panels composed of transportation and planning professionals from the DRCOG region and adjacent regions. Both the Policy and Technical panels are composed of customers of DRCOG's planning and data analysis work. The panels include representatives of DRCOG member governments, regional transportation, planning, and environmental agencies, as well as representatives of environmental groups and private sector companies.

Prior to the first Peer Review Panel meeting, both local panels met (the Technical Panel on September 12th and October 17th, and the Policy Panel on September 26th), for the purpose of developing initial project guidance that could be used to help frame the Peer Review Panel discussions. Both local panels focused on identifying key issues of concern to them that could potentially be better supported by an improved modeling system. In both panel meetings, the issues of greatest importance to the panelists were identified.

Policy Panel Issues:

- What is model's purpose? Is it an analytical tool, or a decision support tool?
- How can the timeliness of modeling process be improved?
- How can modeling of transit be improved?
- The model must do more to address the changing character of the region.
- Changing demographics and travel patterns must be better reflected.
- Appropriateness of outputs - what gets reported?
- Estimation of system performance matters, but so does how it's reported.
- The model must produce information, not just data.
- Better modeling of freight is needed.
- Improved model accuracy is needed, but also clarification for users of how accurate they are - error bars or equivalent.
- Improve the adjustment of model outcomes based on observed outcomes.

Technical Panel Planning Issues:

- Maintaining the existing system.
- Increasing the share of alternative modes.
- Enlarging the transit system.
- Maintaining environmental conditions.
- Increasing highway capacity.

Technical Panel Model Recommendations:

- The model should capture trip-chaining behavior.
- Improve the evaluation of congestion influences on trip decisions.
- Do a better job of capturing economic effects - evaluate the effect of the transportation system on local development; and the effect of local development on transportation demand.
- Improve the model's ability to evaluate cost effects on trip and mode choices
- Better represent system performance factors

IV. Addressing Regional Issues Through Modeling Approaches – Updates from Other Regions

As part of the IRM Vision Phase work, pbConsult is under contract to DRCOG to provide technical support on several tasks. The first of these tasks, presented at the Peer Review Panel meeting, involved review of other cities in North America and Europe that have implemented advanced modeling structures. pbConsult reviewed the following cities, and provided brief descriptions of their models to the project team and to the Peer Review Panel:

- San Diego (focusing on its data management system)
- Houston (focusing on its mode choice model)
- Honolulu (focusing on its implementation of UrbanSim)
- Edmonton, Alberta
- Portand, Oregon (both its trip and tour-based models)
- Stockholm, Sweden
- San Francisco, CA
- Columbus, OH

These reviews will support the work of all later phases of the IRM Vision Project, such as feasibility, cost, and effectiveness analysis. Their use in this Peer Review Panel meeting was in support of the discussion of the ten key modeling issues described in the next section, providing specific examples of how advanced modeling techniques have been used to address these issues.

V. Peer Review Panel: Responsibilities and Key Agenda Issues

The Peer Review Panel's charge for its October meeting was to help the project team identify approaches to the development of an integrated model. Two separate discussions were conducted during the meeting in support of this goal:

- A wide-ranging discussion of approaches for developing an integrated regional modeling system, touching on shortcomings of four-step model systems, the Denver region's model philosophy and goals, the definition/basics of an integrated modeling system, relevant DRCOG projects in recent years, data issues, etc.
- A more specific discussion of the ten key issues identified by the project team, and how advanced modeling approaches might help to address them.

While the project team identified numerous model issues it would like to address in the IRM Vision Phase, given the time limitations of a one-day peer review meeting, ten key issues were identified for discussion:

1 - Sensitivity to price and behavioral changes
    Location choice
    Use of alternative modes and toll facilities
    Parking
    Energy
2 - Modeling low-share mode alternatives
    Bike and pedestrian
    Work at home
    Dial a ride, Park n ride
3 - Effects of development patterns on travel behavior
    Urban centers
    Activity centers
    Urban corridors
    Urban Growth Boundaries
4 - Effects of system and system condition -
    On development patterns (including location & price)
    On travel behavior (including work choice & induced demand)
5 - Ability to examine policy choices
6 - Improve validity and reliability
    Transit
    Congestion
    Suburb-to-suburb trips

7 - Reflect non-system policy changes
    TDM
    ITS
8 - Ability to show environmental effects
9 - Better information for analyzing impacts on specific sub-groups
10 - Better analysis of freight (or goods) movement

VI. Peer Review Panel Discussions: Summary and Consensus

Morning Discussion – Basics of an Integrated Modeling System

- The Data/GIS system is critical – it is the backbone of the whole effort. Integration starts with an integrated information base.
- Stay disaggregate (not grouped and averaged) as far through the model process as possible.
- What do policy-makers need? This need determines the level of detail (richness) that the model must maintain.
- Do we need several tools for different purposes, or just one?
- Integration also means integration with other organizations, their data, etc.
- Integration means including the variables that matter.
- Integration means that the various model elements have consistent temporal, geographic, demographic and behavioral scales. Consistent assumptions!
- Think about the types of behavioral substitution that occur (example: ride transit to avoid CBD parking charges). Needing the model to show these effects drives your design.
- Think also about the different time scales that different decisions have (example: purchase of house versus selection of job versus purchase of car versus daily selection of travel mode, etc.)
- Think about interactions – intra-household, trip/tour interactions, etc.
- Think of it as an integrated information system. Don't limit yourself on issues just because they are the ones you addressed in the past.
- Is there a danger in trying to get too comprehensive, though? Focus on what is important.
- We can't do a good job of prediction if we don't have the data to tell us what is going on now (and we don't)! We don't understand some of the basic factors that motivate drivers to make the choices they do. We are also very lacking in freight data. Be creative about data. There is more available out there than you think, from many sources.
- What caveats/sensitivities do we need to apply to the results we provide?

- Beware of going to quickly to a sketch model approach. Computers are cheap, and you can run big models very fast.
- Too much disaggregration can produce false precision. However, too much aggregation can foster false complexity, which we then introduce even more complexity to fix.
- Look 15 years into the future. Don't get lost in incrementalism. Have a plan!
- Real assignment microsimulation is very difficult. Is there some middle level of detail that will work? Might want to delay work on this, as the field is changing rapidly.
- Can we make the computer code networks, eliminate all this by-hand work?
- Data model: the field is changing, making it risky to pick an approach. But you do have to pick one, so just do it.
- We need to be plain with our policy-makers. There are some questions we can't answer quickly, if at all.
- The risk is in standing still, not in going forward.

Afternoon Discussion - Modeling Approaches for Key Issues

Note that time constraints permitted only seven of the ten key issues to be addressed during the meeting. The other three will be addressed more fully through internal discussion, working with the consultant team, and through email exchanges with the panelists.

Sensitivity to price and behavioral changes

- Special surveys were necessary to get data for toll roads, due to their small overall share. Generally speaking, special surveys are needed for low-share alternatives.
- May need stated preference data to get at some of this.
- Costs can be complicated by the perceived versus actual cost issue. Subsidies, costs incurred periodically rather than when the service is used (example: transit pass versus paying at boarding) can confuse price perception.
- Sunk cost (you already bought the car) versus margin cost (so now you just pay for gas) can also confuse the issue.
- Be careful not to lump people who don't pay (people whose company pays for their parking spot) in with people who do pay, and "average out" important detail.
- Look at share of overall household expenses that goes to transportation: transportation cost tradeoff against housing cost (the "drive until you qualify for a mortgage" phenomenon).

Modeling low-share modes

- We can get good estimates of trip distance/time for bike/ped by using more detailed basemaps such as TIGER, rather than the sparse model networks.
- Perhaps the bike/ped mode decision is more based on land use characteristics than standard mode choice model inputs such as trip length and cost (i.e., people who want to use those modes choose where they will live so they can use them.)
- We need to model this choice in both places (home location and mode choice.)
- Self-selection plays a big part here, introducing the issue of attempting to model "taste". Identify the points at which people are on the edge of making a new choice in this regard (household lifecycle changes affecting choice of home location and type, for example.)
- Think about the "stickiness" of these choices (i.e., how often people make them.)
- Add it to the model now even if you can't yet forecast input variables. If you don't include it, you've assumed that it doesn't change!
- Teleworking: there are more self-employed people working at home than classic "teleworkers". Ditto for part-time workers.

Effects of development patterns on travel behavior

- Until recently there has been limited data on this: some current useful data comes from the Robert Wood Johnson foundation and the CDC.
- All models and data have massive spatial correlation, making it difficult to actually model choices. We need more than revealed data for this.
- Where should we place our regional investments? Creating land use alternatives, or creating modal choices?
- Urban design must show up in many elements of the model. It must be explicitly dealt with in the land use model. This issue is related to the model level of detail: can TAZs deal with it, or do we need parcel level modeling?

Effects of transportation system and system condition

- Induced demand is in large part already in our models. Induced demand is related to the issue of travel budgets.
- When you feed back transportation conditions to your land use model, you start to see efficient land use distribution. However, this result can generate arguments at times with policy-makers over land develop pattern expectations.
- Don't forget to feed back transit system conditions too, including service levels, overcrowding if any, etc.
- The "shock absorption effect of a fine-grained, grid network has a significant effect on the reliability, and so service level, of the highway network. System reliability is as important as average service level.

Ability to examine key policy choices

- The bad thing about "on the spot" answers is that they can be more subject to error.
- Test the extremes of both land use and transportation policy.
- The POM allows you to articulate the effects of policy choices.
- Create benchmark points, with accessible outputs, to generate information and visual outcomes. Bound the possible answers (bounded rationality).
- The POM or equivalent allows you to get away from specific project analysis and to discuss overall strategies.

Improve validity and reliability

- The key statistic you need from your model is the confidence level of your results for providing "error bands" to policy-makers.
- Models should not be just for mathematicians: they should interpret results for politicians.
- You should show "back-casts" as well as forecasts, to give the policy-makers more confidence in the model's results.
- Include more than just modelers in your development team (i.e., traffic engineers, etc.) A lot of good can be done on the transportation system side.
- We need to do what we can to better model route choice (i.e., traffic path/assignment), as this is the main outcome that many users see. All agree that this is the toughest area of all, but that we must do what we can.
- As you gain experience with TDM marketing, you can do a better job of modeling its effects.

Ability to show environmental effects

- This is another argument for tour-based models.
- EPA is coming out with its MOVES air quality model, maybe next year.
- The Edmonton model does a good job of linking the travel and environmental modeling.
- Air pollution near roadways should be evaluated using line-source modeling techniques. This type of study was done using the Portland model.

Appendix A: Agenda

8:30 a	Welcome and Introduction	Jeff May
8:35 a	Overview	Jeff May
9:10 a	Review of Key Regional Issues	Jeff May
9:30 a	Creating an Integrated Modeling System: Data To Policy	Erik Sabina
9:45 a	Break	
10:00 a	Discussion: Integrated Modeling System	Simon Montagu Facilitator
12:00 n	Catered Lunch	
12:30 p	Addressing the Regional Issues through Modeling Approaches – Updates from other regions	Bill Davidson
1:30 p	Discussion: Modeling Approaches for Key Issues	Erik Sabina & Greg Erhardt Facilitators
2:30 p	Break	
2:45 p	Continue Discussion: Modeling Approaches for Key Issues	
4:15 p	Summary and Next Steps	Erik Sabina

Appendix B: Attendees

Peer Review Panel Members:

- Frank Spielberg, Panel Chair – Principal, BMI-SG
- Keith Killough – President, KLK Consulting
- Keith Lawton – Director of Technical Services, Portland METRO Planning Department
- Eric Miller – Acting Chair, Department of Civil Engineering, University of Toronto
- Michael Morris – Transportation Director, North Central Texas Council of Governments
- Michael Replogle – Transportation Director, Environmental Defense

Project Consultants: Bill Davidson, Joel Freedman, John Gleebe – pbConsult; Paul Waddell – Professor, University of Washington

Project Team Members and Observers: Andrew Goetz, Professor, University of Denver; Hui Liang Liu, City of Aurora; Randall Rutsch, City of Boulder; Jeff May, DRCOG MVRC Director; Tim Baker, William Johnson, Juan Robles – CDOT Division of Transportation Development; Lee Cryer, Deborah Weaver – RTD Service Planning Group; Terence Quinn, DRCOG MVPO; Simon Montagu, DRCOG GIS Group; Jeff Romine, Christine Dumas – DRCOG Economic Analysis Group; Erik Sabina, Greg Erhardt, Amanda Penner, Lan Nguyen, Shahida Mirza, DRCOG Travel Forecasting Group

Appendix C: See attached powerpoint presentations.